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ABSTRACT

This paper reports a study of the verbal behaviors of teachers who had participated in a program designed to enable them to exhibit behaviors which promote inquiry learning on the part of their students. Ten BSCS teachers participated in the study. Verbal behaviors occurring in inquiry situations were compared with those in noninquiry settings, using three observational instruments: the Flanders system, the Revised Inquiry Analysis Instrument, and the Affective Behaviors Instrument. Teachers were found to talk the most in a noninquiry setting, less in a teacher-centered inquiry setting, and least in a student-centered inquiry setting. The total proportion of teacher talk decreased throughout the program but became more direct in student-centered inquiry than in either teacher-centered inquiry or noninquiry settings. This may have been due to the percentage of time they spent responding to students' questions in student-centered inquiry as opposed to other types of teacher talk. The investigators concluded that, using a well-designed staff development program, teachers can modify their behaviors and thereby promote more effective inquiry. A related document is SE 017 734. (PEB)

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VERBAL BEHAVIORS OCCURRING IN BIOLOGY CLASSES ENGAGED IN INQUIRY LEARNING

by

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Introduction

In the past decade, much attention has been devoted to the topic of inquiry learning. Support for incorporation of the inquiry process as well as factual content in science classes has been especially strong. A large variety of curricular materials have been designed to promote inquiry learning and have been made available in most areas of science. Even so, teaching behaviors too often remain unchanged from the approaches of the more traditional curricula.

It was this concern along with parallel forces in teacher education to increase the variety of skills possessed by teachers, that led to the development of the Instructional Staff Development Program in Inquiry. This program was designed at the University of Nebraska-Lincoln, Teachers College, in cooperation with the Mid-continent Regional Educational Laboratory, Kansas City.

This program was designed to enable teachers to exhibit behaviors which would promote inquiry learning on the part of their students. More specifically, it would enable teachers to:

1. Recognize they can control their instructional behaviors.
2. Recognize the importance of various inquiry skills and to use these in their teaching.
3. Recognize and use the cognitive behaviors of inquiry including the behaviors of; identification of problems, hypothesis formation, data gathering, data analysis, drawing conclusions, and assessment.
4. Recognize and use the affective behaviors in the areas of openness and inquiry orientation.
5. Recognize the importance of incorporating both content and process in planning for inquiry.
6. Recognize and use a variety of strategies of inquiry.

The Instructional Staff Development Program in Inquiry was developed and field tested over a four year period. This year it has been implemented with teachers in a variety of content areas.

Problem

The purpose of the study was to compare the verbal behaviors of inquiry with those used in noninquiry settings in BSCS biology classes.

Population

Ten BSCS biology teachers in the Omaha, Nebraska, area participated in this study. Selection was on the basis of those biology teachers who were enrolled in the 1971-1972 Instructional Staff Development Program in Inquiry which was offered by the University of Nebraska-Lincoln in cooperation with the Science Center of the Omaha Suburban Area Council of Schools.

Procedures

Each biology teacher was videotaped in one randomly selected class three times; prior to participation in the program, at an intermediate point in the program, and at the end of the inquiry program. Verbal behaviors occurring in these videotaped sessions were coded using the following observational instruments;

1. Flanders Interaction Analysis was used to identify verbal influence used by the teachers;
2. The Revised Inquiry Analysis Instrument was used to identify specific inquiry behaviors; and
3. The Affective Behaviors Instrument was used to identify the affective behaviors which promote inquiry.

For purposes of this study, inquiry was defined as "a set of activities directed towards solving any number of related problems in which the student has as his principal focus a productive enterprise leading to increased understanding and application."[1]

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[1] Inquiry Objectives in the Teaching of Biology, Richard M. Bingman, Editor, Mid-continent Regional Educational Laboratory, Kansas City, Missouri, 1969, p. 1.

Three teaching strategies were identified for the purpose of analysis:

1. Noninquiry in which the cognitive inquiry behaviors (identification of the problem, hypothesis formation, data gathering, data analysis, conclusions, and assessments) were not observed to be used in seeking a solution to a problem;
2. Teacher-centered Inquiry in which the cognitive inquiry behaviors were being used to seek solutions to problems, and the teacher assumed a major role in the inquiry process; and
3. Student-centered Inquiry in which the cognitive inquiry behaviors were being used in seeking solutions to problems, and the students assumed the major responsibility in the inquiry process while the teacher assumed a relatively minor role.

Results of the observations in this study were summarized in the following way:

1. Percentages of teacher and student talk which occurred in noninquiry, teacher-centered inquiry, and student-centered inquiry settings.
2. Percentages of teacher talk identified as "indirect" in noninquiry, teacher-centered inquiry, and student-centered inquiry settings.
3. Percentages of cognitive inquiry behaviors used in noninquiry and student-centered inquiry settings, and the proportion of these behaviors used by students.
4. Percentages of affective inquiry behaviors used in noninquiry and student-centered inquiry settings, and the proportions of these behaviors used by students.

Results

Graph I shows the mean percentages for teacher and student talk for the ten BSCS biology classes. Percentages ranging from zero to eighty percent were recorded in the areas of teacher talk, student talk, and silence or confusion for the three teaching strategies of noninquiry, teacher-centered inquiry, and student-centered inquiry.

In the noninquiry setting the average percentage of teacher talk was 80.9% with only 18.7% student talk and 0.4% silence or confusion.

In the teacher-centered inquiry setting, the percentage of teacher talk was reduced to 61.8% while the percentage of student talk increased to 30.2% with silence or confusion increasing to 8.0%.

In the student-centered inquiry setting, percentages of teacher talk decreased to 23.7% while student talk climbed to 76.0% and silence or confusion dropped to 0.3%.

The proportions of talk for teachers and for students were approximately reversed from the noninquiry to student-centered inquiry situations. Silence or confusion percentages were highest when the teacher was indirect.

Graph II indicates the percentages of total teacher talk which was indirect. Indirect behaviors include questioning, use of student ideas, positive reinforcement, and acceptance of student feelings as opposed to the direct behaviors of information-giving, direction-giving, and criticizing.

In the noninquiry setting, 36.0% of the teacher talk was indirect. In other words, almost two-thirds of the time 64.0% was spent in direct behaviors. In the teacher-centered inquiry setting almost half (47.0%) of the teacher talk was indirect.

Although the total proportion of teacher talk decreased throughout the program, this talk became more direct in student-centered inquiry than in either teacher-centered inquiry or noninquiry settings.

As teachers moved from noninquiry to teacher-centered inquiry, they talked less, but they were more indirect. However, in student-centered inquiry, teacher talk was less frequent but the teachers' influences became highly direct.

Graph III contrasts the average percentage of time spent using verbal cognitive inquiry behaviors in the noninquiry and the student-centered inquiry settings. The graph shows the cognitive behaviors used most frequently were; "use of factual data", "data analysis", and "procedures".

In noninquiry classes, verbalization of "factual data" took approximately two-thirds (65%) of the total time as compared to 37.6% of the time spent on factual data in the student-centered inquiry setting. "Data analysis" occurred 8.6% of the time in noninquiry settings while approximately one-fourth of the time was spent in this behavior in student-centered inquiry. The "procedures" category was coded 5.8% of the time in noninquiry as compared to 14.6% in student-centered inquiry.

The other inquiry behaviors category included; identification of the problem, hypothesis formation, assessment, conclusions and sensory observations. These were low for both noninquiry and student-centered inquiry settings. Perhaps these behaviors were verbalized so infrequently that comparisons with the time spent on the behaviors of data gathering, data analysis, and discussion of procedures were difficult.

In student-centered inquiry, data analysis (24.3%) was carried out totally by students while in noninquiry they analyzed data only 3.8% of the time. Procedures were seldom verbalized by students in noninquiry while almost two-thirds were verbalized by students in the student-centered inquiry. Use of other cognitive inquiry behaviors changed little in these two settings. In all cases, the proportion of cognitive behaviors used by students increased from the noninquiry to the student-centered inquiry settting.

Another dimension of the inquiry verbal behaviors studied was that of the affective behaviors which promote inquiry. These behaviors were specified in two areas, Openness and Inquiry Orientation, and are reported in Graph IV.

Total behaviors for both teachers and students of "willingness to express divergent views" and "willingness to subject data and opinions to criticism" were openness behaviors which increased from noninquiry to the student-centered inquiry setting (3.6% to 7.7%) and 4.3% to 7.7% respectively). Expression of "respect for ideas of others" occurred more frequently in the noninquiry setting (16.1%).

Inquiry Orientation behaviors included four categories; (1) "expresses understanding of the inquiry process", (2) "expresses preference for use of evidence to support data", (3) "expresses satisfaction with the process of inquiry", and (4) "expresses evaluation of himself and/or the group". The two categories of "expresses understanding of the inquiry process" and "evaluates himself and the group" occurred more frequently in the student-centered setting (increases of 4.2% to 9.7% and 0.2 to 2.4% respectively). "Expression of preference for use of evidence to support data" was used more frequently in noninquiry (3.9%). "Expression of satisfaction with the process" seldom occurred in either setting which may indicate that this behavior is not often expressed verbally.

In all affective categories of openness and inquiry orientation, the percentage of student use of each behavior was greater in the student-centered inquiry setting than in the noninquiry setting.

Conclusions

The results of this study support the following conclusions:

1. Involvement of students as indicated by verbal behaviors is low in the traditional, noninquiry classroom.

2. The use of either teacher-centered or student-centered inquiry strategies increases the verbally expressed student involvement, with the greatest student involvement expressed in the student-centered inquiry strategy.

3. Teachers tend to use more indirect behaviors as they move from traditional, noninquiry strategies to teacher-centered inquiry strategies.

4. Teachers talk very little in student-centered inquiry, but their verbal influence becomes highly direct.

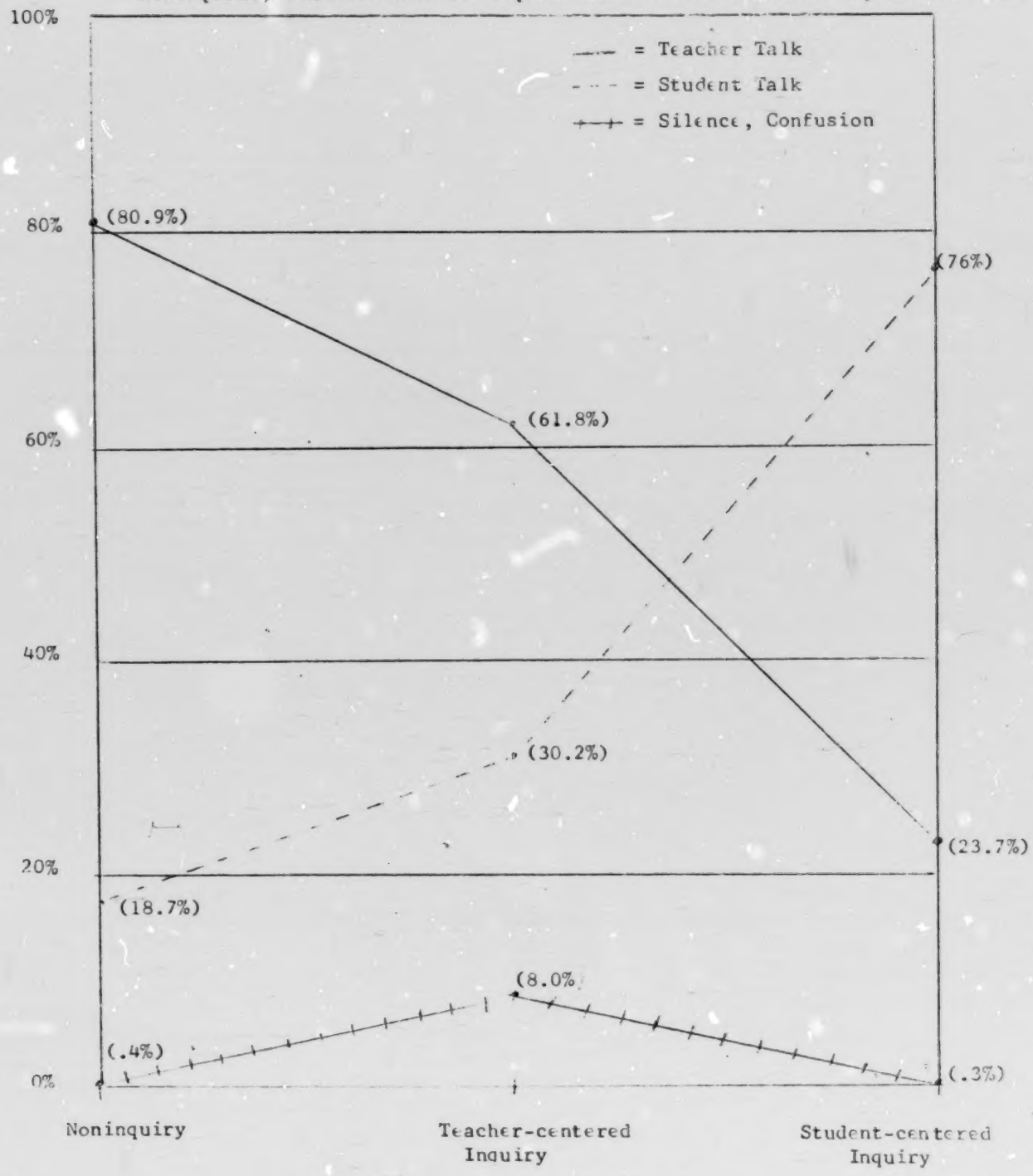
5. Students' use of cognitive or affective verbal inquiry behaviors seldom occurs in the traditional classroom setting, but can be substantially increased by implementing the student-centered inquiry strategy.

Implications

If the purpose of inquiry learning is to develop in students the ability to use the skills and attitudes or values which promote effective inquiry, then it is essential that teachers provide settings in which the student will be an active participant in this process. It is not likely that the traditional teaching strategies will move students in this direction. However, with the assistance of a well-designed staff development program, teachers can modify their behaviors and thereby promote more effective inquiry.

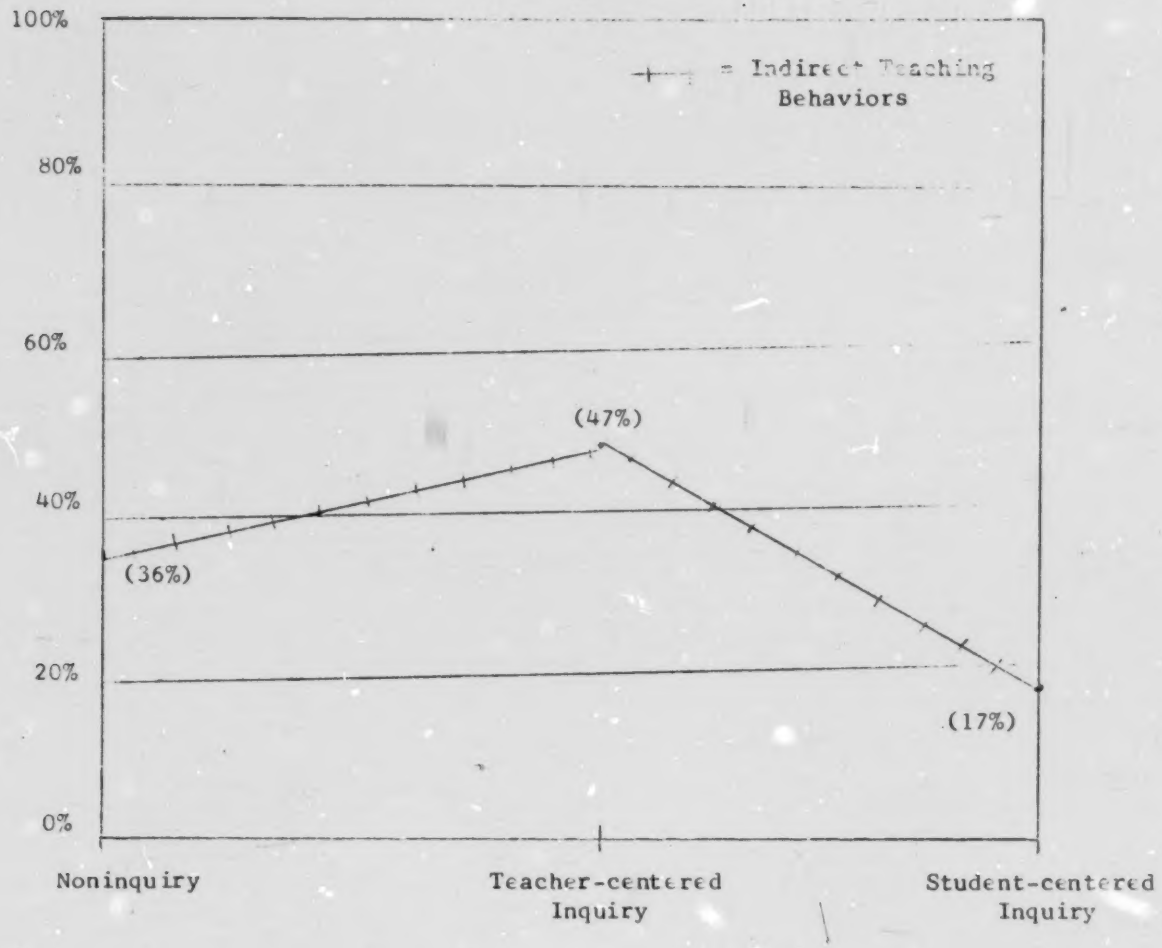
GRAPH I

PERCENTAGES OF TEACHER AND STUDENT TALK IN
NONINQUIRY, TEACHER-CENTERED INQUIRY AND STUDENT-CENTERED INQUIRY SETTINGS



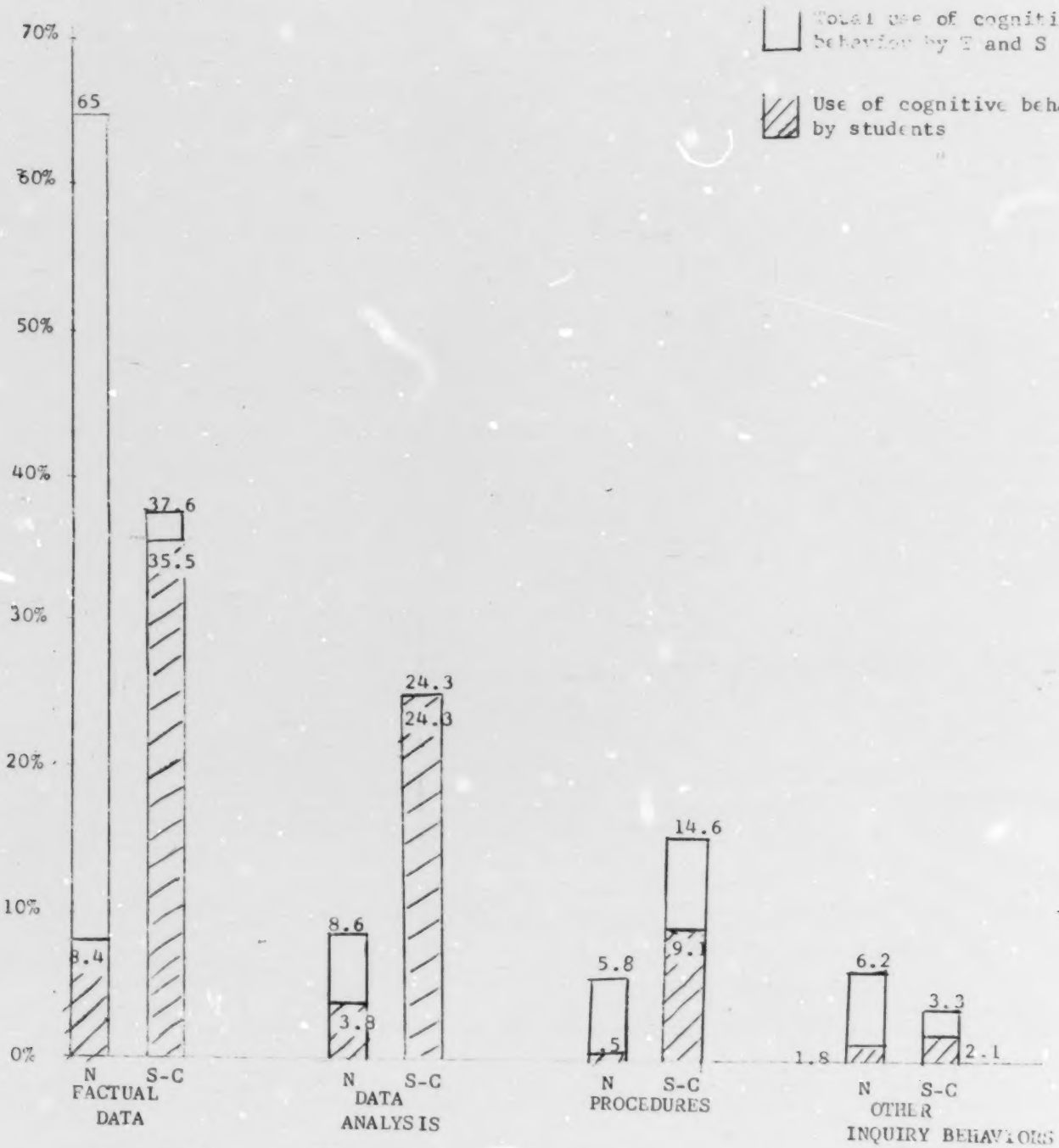
GRAPH II

PERCENTAGES OF INDIRECT VERBAL BEHAVIORS USED BY TEACHERS IN NONINQUIRY, TEACHER-CENTERED INQUIRY AND STUDENT-CENTERED INQUIRY SETTINGS



GRAPH III

COGNITIVE INQUIRY BEHAVIORS USED IN NONINQUIRY AND IN STUDENT-CENTERED INQUIRY IN TERMS OF TOTAL BEHAVIORS AND STUDENT USE OF THESE BEHAVIORS



N = Noninquiry

S-C = Student-Centered Inquiry

GRAPH IV

PERCENTAGES OF AFFECTIVE VERBAL INQUIRY BEHAVIORS USED IN NONINQUIRY AND IN STUDENT-CENTERED INQUIRY IN TERMS OF TOTAL BEHAVIORS AND STUDENT-USE OF THESE BEHAVIORS